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ABSTRACT

This study outlines some considerations for an economic model of the scientific journal market. The model provides an explanation of journal market structure and the dynamics of market behavior, as well as a description of journal market development. Three types of periodicals are discussed: (1) primary, archival journals serving a current awareness function; (2) secondary journals abstracting and indexing primary literature; and (3) tertiary journals reviewing literature to evaluate the current state of knowledge. The organization of the primary journal market and the relationships of the participants are discussed. The cumulative nature of scientific research increases demand for scientific journals, as research builds on previous findings. Journals need financial subsidies from volunteer services and foundation and government grants. The criteria used to judge journals' performance are consumer satisfaction, allocative efficiency and innovative efficiency. A journal's functions are outlined: recording information, disseminating information, and adding to the prestige and recognition of scientists. Demand for journals derives from the suppliers of manuscripts, individuals, libraries and bibliographic services. The supply of journals depends on production costs, which are analyzed in detail. Factors specific to language science journals are discussed. The LINCS program and the "Linguistic Bibliography" are noted as factors in information dissemination. Institutional cooperation in publishing would yield great scientific and economic benefits. (CHK)

CENTER FOR APPLIED LINGUISTICS

LANGUAGE INFORMATION NETWORK AND CLEARINGHOUSE SYSTEM (LINCS)

TOWARD A MODEL OF JOURNAL ECONOMICS IN THE LANGUAGE SCIENCES

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With an appendix by

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NOTE

This research was initiated while Professor Berg was a Research Fellow at the Brookings Institution. He is currently Assistant Professor of Economics at the University of Florida.

1. INTRODUCTION

The purpose of this study is to outline some of the considerations for an economic model of the scientific journal market. The model pro es an explanation of journal market structure and the dynamics of market behavior, as well as a description of journal market development. The conceptual framework is preliminary in nature, and highly simplified, but it provides a basis for future work in the area of journal economics. Also derived from the framework is the effect of market growth upon the costs of bibliographic services.

The basic terms and concepts used here must be defined and explained. The market is essentially the grouping of producers and consumers -- or mix of participants -- which determines the level of production and purchase of journals. Demand refers to the quantity of journals purchased at different prices. The derivation of demand involves a combination of the potential journal consumer's needs with his desire and ability to pay for the journal. Supply refers to the number of copies of a journal available at a given price, which is in turn determined by the technology available and the goals and revenue sources of the publisher. Financial Viability encompasses the feasibility of a particular journal or an entire journal system's continued existence.

Before employing these concepts in a characterization of the journal market, it may be useful to differentiate the kinds of journals available. Three types of periodicals are identified on the basis of information content:

(1) Primary - journals which are archival in nature but also serve a current awareness function.

(2) Secondary - journals which abstract and index articles appearing in the primary literature.

(3) Tertiary - journals which review literature to evaluate the current state of knowledge for those who do not have sufficient time to keep up with the rapid growth of the literature.

Each type of journal has its own specific problems but the model is general enough to include them; however, for the sake of simplicity of discussion and illustration, the focus of attention throughout the text is the primary journal market.

2. THE PRIMARY JOURNAL MARKET: GENERAL CHARACTERISTICS

The organizational elements of the primary journal market may be arranged in three categories: participants, inducements, and contributions.[1] The chart below indicates the relationships among these elements:

Organization of the Primary Journal Market

Participants	Inducements	Contributions
1. Authors	Prestige, feedback	Articles
2. Subscribers	Information-content of journals	Revenue
3. Editors	Prestige and/or Salaries	Screening
4. Publishers/ Administrators	Prestige or Profit	Organization, risk-bearing
5. Printers	Payments	Manufacture of journals

When the market is in equilibrium, there is no tendency for the participants to disturb the number of journals, their circulation, or their financial viability. Participants are just able to generate the inducements necessary to keep the various contributions stable. The situation is not static, however, and the dynamics of scientific research cause disequilibriums. For example, unless the number of published pages increases with an increase in the number of author-participants, there is pressure for the establishment of new publication outlets. Similarly, as the number of subscribers (who may also be authors) rises, they desire and are able to support more specialized journals. Subsequent sections of this study examine some of the dis equilibrating factors which influence the organization of the journal market.

2.1. Functional Relationships

Before illustrating the functional relationships in the journal market, two characteristics of scientific information should be noted; these are major determinants of the evolution of the journal network:

(1) Scientific information builds upon past research and thus is cumulative in nature,

(2) Scientific information is expensive to produce but relatively inexpensive to reproduce.

The cumulative nature of scientific information influences demand for journals since past research serves as an input into the production of new scientific information. The supply of published articles reflects the second characteristic of scientific information; the costs of preparing the input are large relative to the costs of reproducing copies of that input. The fixed or first-copy costs cover the screening of articles and the production of the first copy of the manuscript as well.

Hence, the two characteristics affect the demand for and the supply of journals within any discipline. Without dissemination, fellow scientists cannot build on past research. Without screening, those utilizing research results might be inundated by vast amounts of unevaluated information; the high fixed costs of publishing necessitate the careful screening of articles, which imposes additional prerun costs. Awareness of these characteristics of scientific information is essential for an understanding of journal market evolution; the characteristics also affect the market relationships diagrammed in Figure 1.

Information on current technology is available but it is quite clear that computer technology may rapidly change the whole area of production capability and cost. For now, the components of technology under consideration include (1) the editorial services, (2) the administrative services, and (3) the printing services.

Needs are the desires for information -- on particular subjects or research techniques. The desired product may or may not exist. In the absence of information the need may be great, but even with the apparent availability of relevant information, needs may still be unmet due to dissemination time lags or prohibitive acquisition costs. It is in the context of money exchange that needs make themselves apparent as demand. There is no evidence for evaluating an information product until consumers indicate the maximum price they are willing to pay for that information. Thus, needs may be viewed as unexpressed demand. The level of need is influenced by (1) the number of potential subscribers and authors, (2) the possible use of information, and (3) the effectiveness of substitutes for primary journals. Substitutes may include informal seminars, conferences, and preprint services.

The Institutional Arrangements reflect the role of libraries, societies, universities, government agencies, and commercial firms in providing funds necessary to help keep a journal financially viable. Journals often require revenues in addition to those generated by subscriptions and advertising to offset the high fixed cost of publishing; the deficit may be relieved by institutional grants. Much non-profit institutional backing involves volunteer labor; but as organizations grow, full-time professionals may be necessary and this increases the financial burdens of journal publication.

Libraries recognize that they service many readers and potential subscribers, and are often willing to pay more for issues than individuals or members of scientific societies; for some journals, the majority of subscribers consists of libraries. Societies volunteer labor, mostly in the form of editorial services, and often set membership dues to include subscription fees. Universities provide overhead-type facilities and administrative skills when they sponsor journals. Government grants to societies and other organizations often are aimed at improving communication networks. For example, the National Science

FUNCTIONAL RELATIONSHIPS

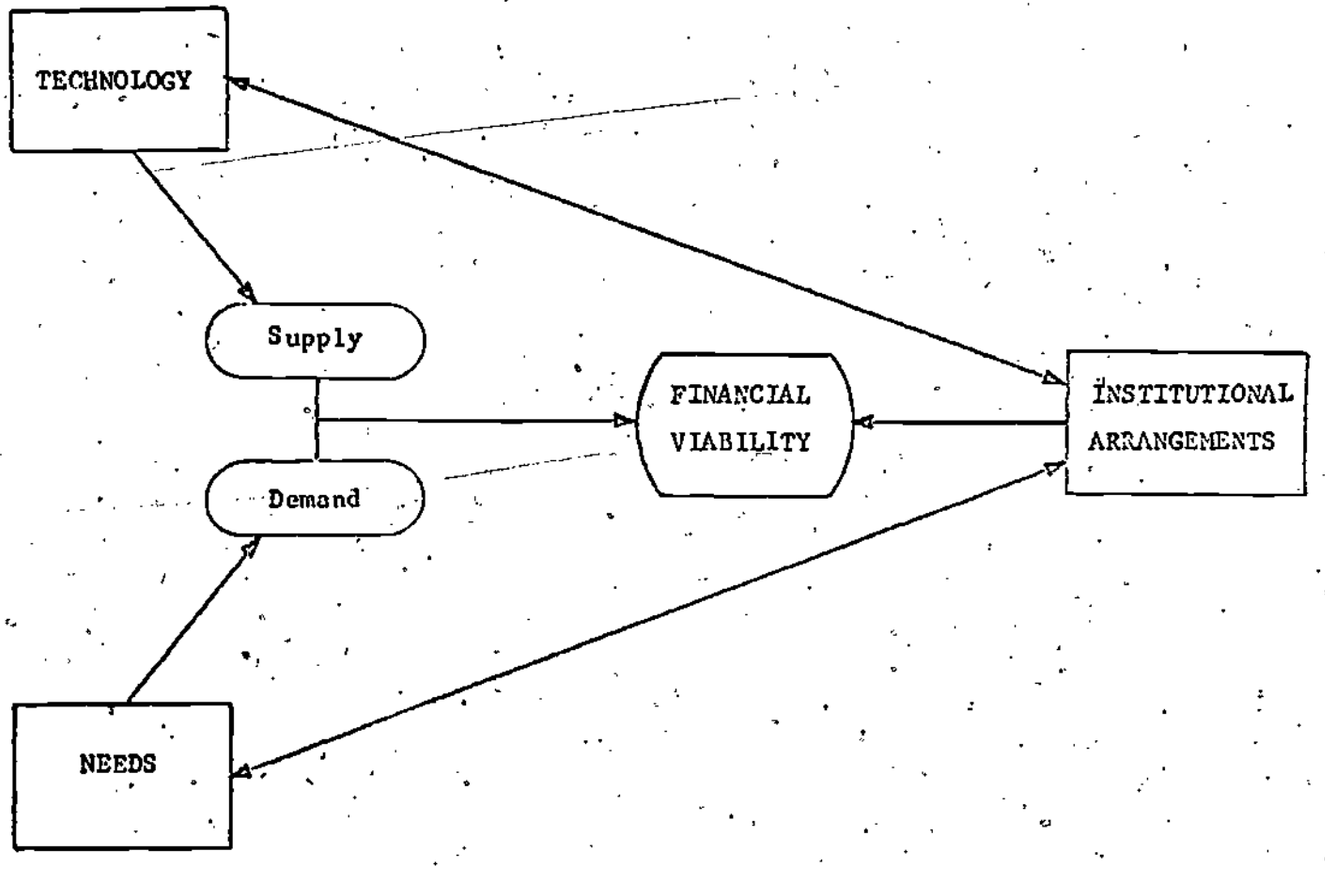


Figure 1

Foundation has supported developmental work in many disciplines. Finally, commercial firms fill gaps in the literature by selecting products useful to researchers and practitioners. By definition, their role involves innovation and risk bearing, without explicit subsidization by other groups.

Given the technology of producing journals, costs can be derived (this is done in a later section). If the revenues generated by demand do not offset the costs, and the slack is not taken up by the institutional arrangements, then financial viability is threatened and alternatives must be explored. For example, different production techniques may be developed to reduce the high fixed cost of typesetting, or page charges to the sponsors of research may be required before articles are accepted for publication.

The elements in Figure 1 are mutually conditioning; one-way causation is the exception rather than the rule. For example, disciplinary needs may bring about institutional arrangements to meet the needs. Initially the needs were not expressed as effective demand since the product did not exist -- no monetary exchange could take place. Similarly, institutions may influence perceived needs if they find that the available technology permits the introduction of new products. Institutions interact with needs and technology in determining market equilibrium. The evaluation of that equilibrium should reflect how well institutions have been able to meet those needs with the available technology.

2.2. Standards of Performance

Several criteria should be used to judge performance of the producers in a journal market. One criterion is the amount of consumer satisfaction, or dissatisfaction, displayed for a journal product; the amount of satisfaction is responsive to pricing policies, content (the degree of specialization and selective screening of articles), the size of the journal, and frequency of publication. Consumer satisfaction is manifested both through demand (expressed need) and influence exerted through institutional arrangements.

Another dimension of market performance is the allocative efficiency with which the various inputs are combined. In a fragmented market, there may be little incentive to use the latest technology, either because of scale requirements, constraints on the mix of productive inputs, or managerial inefficiency. In analyzing performance, administrative procedures and personnel can be judged for efficiency of operation; printing and distribution can be evaluated to see if least-cost methods are being employed; and pricing policies can be examined to see if any potential purchasers are being excluded through high prices.

Innovative efficiency is the dynamic dimension of performance evaluation. Over a period of time, producers adopt new techniques, develop new products, and expand into new markets. The lags in using new technologies, in matching products to consumer tastes, and in identifying new markets all reflect how the institutions are performing over a period of time.

3. FUNCTIONS OF A JOURNAL

Primary journals serve simultaneously as a medium for announcing new knowledge, for storing tested results, and for establishing reputations in science. The screening process determines how well the alerting, reference, and recognition functions are performed. Screening is essentially a matter of forcing the three functions to meet standards set by the profession.

3.1. Recording Information

Journals serve as a public archive for obtaining references to past research. Articles must meet standards of accuracy and scientific significance to become part of the scientific record. Hence, screening partly determines the extent to which scientists find back issues useful for literature searches or ideas. This in turn affects how the public benefits from the original processing, recording, and storing of reference material. Articles in this file of screened research are cited to validate the claims of scientists; their research is then embedded in the pre-existing consensus.[3] Formal publication marks the beginning of the period of critical study and testing; if the work proves to be valid and useful, it may make its appearance in textbooks. Tentative research results are thus transformed into what we call scientific knowledge.

A further aspect of this function is the use of the journal for establishing priority. Merton[4] indicates that this is an important element for motivating research. Journals have served this role since their inception.[5]

3.2. Disseminating Information

Individuals subscribe to journals for current information as well as for reference purposes. The announcement or alerting aspect serves the interests of both authors and readers. Since scientists write to stake claims and formally register discoveries, prompt publication is important for the establishment of priority. Scientists tend to read to catch hints of related works; even tentative results can provide clues for further research. Besides stimulating further work, rapid dissemination prevents duplication of research. Effective announcement affects the efficiency of resources going into research. For example, it has been estimated that 0.9 percent of research expenditures in Britain in 1962 was wasted because of some overlap between work in progress or already completed and published.[6]

The delays resulting from understaffing, which characterize the present screening process, conflict with the effective performance of the dissemination function of journals. This situation has led to the establishment of "letters" journals in physics and chemistry which by-pass the usual editorial and refereeing delays. Such specialized journals have appeared because of expanded markets and changed research habits.

Rapid dissemination journals, along with preprints and technical reports, generally keep those working on the research frontier up to date with each others' work. However, early announcement publications which have a minimum of editorial control are not substitues for fully screened, formal presentations of research results. Also, the pressure for early announcement to establish priority may conflict with the goal of accurate presentations.[7]

The two functions discussed above provide a demand-pull explanation for the evolution of the journal market. The articles and reviews are valued for their information content, whether obtained from current scanning, retrospective searching, or browsing. Current expenditures by individuals and institutions reflect the expected information content of the available journals. A supply-push explanation of the journal market is derived from the third broad function of journals in the professional advancement system.

3.3. Conveying Prestige and Recognition

Institutions use publications as a visible means for ranking scientists; scientists, in turn, gain recognition from their peers through the dissemination of their research results. Herschman has described the recognition gained from publication as

> ... our reassurance that our life's work is meaningful as judged by ourselves and by our peers. This recognition, taken together with our need to believe that our intellectual effort was original priority, has been formally validated, and is publically known as our own dissemination, is the social mechanism by which the community encourages us to be scientists.[8]

The role of journals in the academic advancement system results in built-in pressure to publish. Yet unconstrained publication runs counter to the function of providing scientific authenticity for the disciplines' files. The function of providing indices of research excellence for rewarding and advancing scientists is also thwarted by weak screening. In fact, this uncritical screening may be detrimental to the development of a discipline. J. von Neumann noted that

> ... there is grave danger that the subject will develop along the line of least resistance, that the stream so far from its source will separate into a multitude of

> insignificant branches, and that the discipline will become a disorganized mass of details and complexities. In other words, at a great distance from its empirical source, or after much abstract inbreeding, a mathematical subject is in danger of degeneration. At the inception the style is usually classical; when it shows signs of becoming baroque, then the danger signal is up ...[9]

The need is clear for survey and review articles which distill the vast amount of fragmented research. The present reward system does not motivate authors to produce such syntheses. Furthermore, journal editors may be incorrect in deciding what research is neither faddish nor sterile.

4. DEMAND FOR JOURNALS

The discussion of the three basic functions of journals indicates that journals are desired for more than their information content. Since journals are social institutions, any consideration of demand that focuses only on economic factors would be inadequate.

4.1. Demand by the Suppliers of Manuscripts

The pressure for the entry of new journals comes from several sources. If there is a clear gap in the literature published by current publishers, authors and users of such information may press for the formation of a journal to meet their needs. Alternatively, all the articles on a topic may be published (zero rejection rate), but they may be scattered throughout the literature. The specialization and coverage provided by the new journal would meet the needs of researchers and thus find a ready market. Both types of entry may be efficient.

A more questionable source of entry is from the authors who are unable to publish in the present set of journals. That is, an excess supply of manuscripts results in entry. If the new journal was of demonstrably lower quality than others, its circulation should reflect the limited market. However, quality is not the only screen imposed by the editors (which is an imperfect screen, at best, given the element of uncertainty in any piece of research). Publication lags also arise in a field, and the resultant delays cause some pressure from authors for new journals with reduced lags. If such lags do not decrease the value of journals to subscribers, authors - rather than subscribers - should bear the cost of reducing those lags. A by-product of pressure to reduce lags is high quality articles being "spread-out" over the journal space. The result is a reduction of coverage by the established journals, and perhaps, a decrease in the growth rate of demand.[10] Furthermore, bibliographic services are forced to expand their coverage; such expansion can be costly, compared to the number of articles identified by the service.

In Hagstrom's view the formation of scientific periodicals is also a critical step in the differentiation of new disciplines.[11] Thus, a researcher in a field which is broadening its scope may even cease to identify with the traditional discipline: "Only when a periodical is established that is devoted to a field with its own distinct goals and standards will it be possible for him to conceive of himself as a new kind of specialist; only then will it be possible for a self-conscious community of specialists to arise." Entrants into a field bring about a high density of research activity; this, in turn, results in a counteracting tendency to disperse over a wide range of problems. When such dispersal results in the isolation of a particular group with identifiable interests, a new society (and journal) may emerge.

The achievement of a critical mass of subscribers and authors is not an unmixed blessing, however. The secondary services must expand to include this new group. Other primary journals are also affected to the extent that they cannot expect to expand their subscriptions at the previous rate. The same market is now being divided up among more journals.

The evolution of the journal network is reflected in the packaging of screened articles. Just as editors and referees can exert control over the quality of articles appearing in individual journals but not in the literature as a whole, they determine individual packages but not the underlying partitioning of topics within the system. Given the possibility of entry, the specialization of a journal, but not its coverage, can be controlled by its editor. Concepts analogous to those used in the census classification of industries can be applied to the journal market to illustrate this point. If a journal publishes twenty articles, ten of which are on Topic i, its specialization ratio with respect to that topic is .50. If forty i articles of homogeneous quality appeared in the literature during that year, the journal would have a coverage of .25 for that topic. However, if entry occurs and the new journal publishes the twenty i articles ranking just below the accepted forty, the coverage of the original journal drops. Even if the articles were given half-value to make them (qualitatively) comparable to the top forty, the coverage would slip to .20.

Such an event in the evolution of a market is difficult to evaluate. By specializing, the new journal could become the focus of work done by researchers in a discipline, or those at the juncture of several disciplines. With less scattering of articles, the researcher should find it easier to keep abreast of developments. Over time, this improvement in the accessibility of high quality research may be reflected in higher (redefined) specialization and coverage ratios.

A precise characterization of these concepts is seen in the matrix below, where Aij is the number of articles on topic i appearing in journal j (with Aij often equal to zero):

	journal 1		journal J	
topic 1	A_{11}, A_{12}		A_{1J}	
	A_{21}		A_{2J}	
	:		:	
topic K	A_{K1}		A_{KJ}	$\sum_{j=1}^{J} A_{Kj} = A_{K*}$
	$\sum_{i=1}^{K} A_{ij} = A_{*J}$			

Here, there are J journals and K topics. Two summations provide examples of how the specialization and coverage ratios are derived. A_{K*} is the total number of articles on topic K and A_{*J} is the total number of articles in journal J. The entry of a new journal causes the addition of another column and thus affects the coverage of the other journals where

(1) $Cij = \frac{Aij}{Ai*}$ = coverage of topic i by journal j, and

(2) $Sij = \frac{Aij}{A*j}$ = specialization in topic i by journal j.

The problems facing bibliographic services become clear when one considers that each year a new and larger matrix of articles is added to the past matrices.

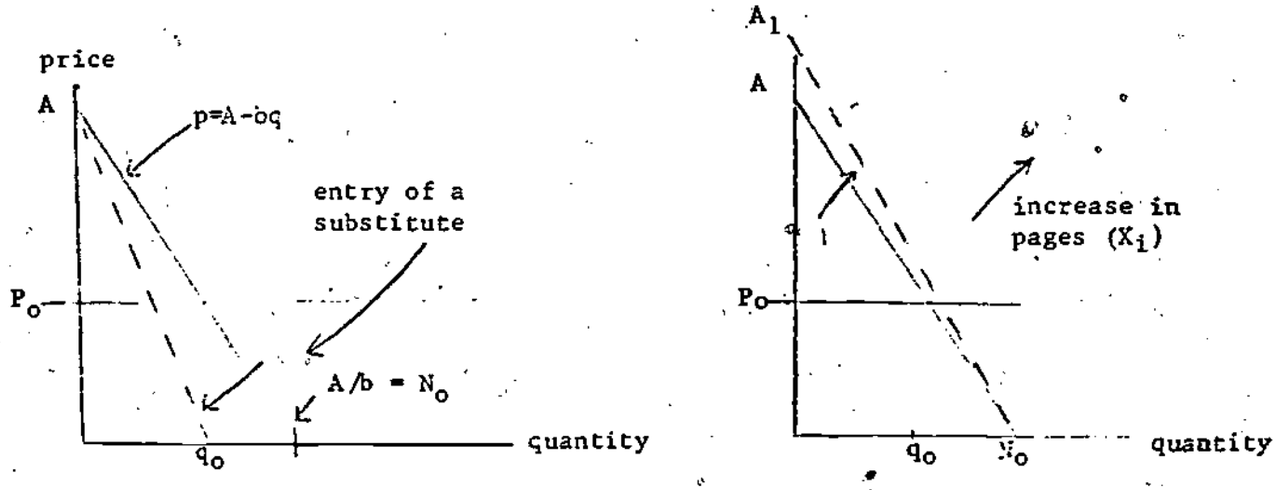
Future studies of the journal network in Language Sciences will examine the specialization and coverage of core journals. Other disciplines, such as Physics, already have collected such statistics and have analyzed them in terms of the needs of the scientists in that discipline. Another way of evaluating the dispersion of articles is through the use of citation analysis. Current studies of the Language Sciences indicate a substantial dispersion of citations, which implies that secondary services should stress coverage rather than speed of announcement. The average age of the cited articles is several years older than in fields such as chemistry and physics which are changing quite rapidly. Given a limited amount of resources to be devoted to secondary coverage, the trade-off between speed and comprehensiveness of coverage is heavily in favor of the latter. One problem with these conclusions is that the authors were operating under the present system, so there are no data on how they might cite recent articles or those from near-by disciplines if the secondary services were improved. This is an area where experimentation must continue.

4.2. Demand by Individuals and Libraries

Even expenditures for journals that are justified strictly in terms of information content cannot be considered a completely economic decision. The demand of institutional subscribers may reflect inertia rather than any conscious maximizing decision. However, an economic model of demand would relate the circulation (quantity demanded) of one journal (q_i) to price (p_i), to the degree of specialization of the journal (s_i), its coverage (c_i), the number of research pages (x_i), the quality of the screening process (z_i), and these same variables for related journals:

$$q_i = q_i(p_i, s_i, c_i, x_i, z_i \; ; \; p_1, p_2, \ldots; \; s_1, s_2; \ldots)$$

This is a very complex formulation, since it contains the information on the array of substitutes as well as the particular journal. Holding all other variables constant, a linear demand curve might be postulated:



The linear demand curve is rather simplistic, but it illustrates how the size of the potential market (N_o subscribers at a zero price) affects sales; for example, entry will shift the curve in. Furthermore, an increase in the value of the information (either through an increase in x or z) expands sales. More complicated functional forms could be developed, but these diagrams should serve to illustrate how an economist might view the problem of demand.

Some progress has been made on applying statistical analysis to the analytical framework described above. Demand parameters have been estimated with circulation as a function of price, pages, the size of the market, and quality variables. Estimates for single journals over time are found in studies by Berg[12] and Barzel.[13] Berg's results indicate that library circulation is very unresponsive to price, but fairly responsive to increases in pages published. Individual subscriptions

are not quite as unresponsive to price, but they are not too responsive to changes in the number of pages. Preliminary cross-section studies of a large number of journals in mathematics, economics, and biology substantiate the general conclusions, while permitting the impact of additional variables to be examined. The expanded demand equations use journal age, rejection rates, publication lags, various types of sponsorship (scientific societies and university presses), and other characteristics of the journal (including its appeal beyond the immediate discipline and whether the journal is quantitative/ theoretical in nature).

Despite this research, much more information is necessary on the number of potential subscribers to journals, the overlapping subscriptions to journals, the extent of library support, and differential pricing policies of the journals.

4.3. Impact on Bibliographic Services

In the Language Sciences, a number of journals with small circulations may be of interest to a substantial number of professionals. The accessibility of these journals is important to the development of the discipline. Studies on the availability of journals or reprints of articles would determine how present networks might be improved. Experiments with the selective dissemination of information would also provide experience in linking language scientists together through other channels. Information on overlapping memberships would provide clues as to the size of current communications networks; the producers and users of research results should be identified, and their needs monitored.

Similarly, the potential demand for secondary and tertiary journals should be examined. Neither of these services have the prestige factors which enable the operation of the primary journal network. Commercial firms or societies must provide the resources necessary for adequate coverage of the literature. Information sources are generally discipline-oriented, so the acquisition of article titles and abstracts requires the technical skills of language scientists. However, the processing of the information should be science-oriented, so that implications for other disciplines are clear. Similarly, the output phase of abstracting should be mission-oriented so that research results can be put to use by practitioners. For example, research in the narrow areas of sociolinguistics has implications for broader fields such as education, mass communication, and speech therapy. The abstracting and review services must ensure that discipline-based research can be of use to those in applied fields. Given the tendency for authors to base submission decisions on self-interest, there is no "invisible hand" to direct others to their research results.

5. SUPPLY OF JOURNALS

Two elements must be taken into account when discussing the costs of journal production. First, there is great scope for variety both in the nature of the journal and the production process. Second, fixed (or prerun) costs play a major role in determining the viability of a journal. Language science journals are produced under a variety of organizational and technological arrangements. The dependence of American language scientists upon journals originating in nearly one hundred countries complicates any discussion of costs since an adequate sampling of costs would not only be expensive, but not very useful in terms of current policy needs. A general model can be developed to indicate the trade-offs facing journal publishing, however.

5.1. Cost of Journal Production

Much of the information now available on the cost of journal production has been generated by the National Science Foundation. Past studies of journal economics have generally involved the collection of survey data from editors and a comparison of variables such as circulation, the discipline, and the type of sponsor. While this section is concerned primarily with the first of these factors, organizational matters such as discipline and sponsor which may affect the cost of production are also discussed.

An outgrowth of the 1950 Conference on Primary Publications was a 1953 NSF Survey which focused on sources of costs and income for journals with different levels of circulation.[14] This survey of one hundred ten journals provided information on various components of cost. Items related to the manufacturing process took up about 80 percent of total costs for journals with circulations less than 1000 and about 64 percent of total costs for journals with greater circulations. Fixed cost items -- items independent of the number of subscribers -- account for a much larger proportion of costs for journals with circulations less than 1000. On the manufacturing side, composition and engraving made up 60.6 percent of costs for small circulation journals, with administrative overhead another 16.2 percent. These proportions can be compared with 30.1 and 12.1 percent for the journals with circulations between 1000 and 8000. While information on the number of pages would have been desirable for estimates of costs, the economies of scale are clear.

A later series of studies presented information by discipline and show how the organization of the journal market affects the viability of journals.[15]

Of more direct relevance to the problem of journal costs are the studies done by the Operations Research Group of the Case Institute of Technology for the National Science Foundation.[16]

These studies by the Operations Research Group estimated manufacturing costs of journals produced in the United States. The equation estimated in 1963 is shown below:

$C = F X + V X Q$

C = total cost per issue

F = fixed or circulation-independent costs

(a) Composition

(b) Engraving

(c) Alterations

X = number of pages per copy

Q = number of copies per issue

V = variable or circulation-dependent costs

(a) Printing, presswork and binding

(b) Paper stock

(c) Mailing (but not postage)

(d) Postage

The results depended upon the complexity of the composition, with complex including a relatively large number of formulae and tables, moderate being primarily prose with some equations, and simple being predominantly prose:

1. Two columns

   C = \$20.25 x +\$0.0034 x q

2. Complex composition

   C = \$15.25 x +\$0.0026 x q

3. Moderate composition

   C = \$13.88 x +\$0.0035 x q

4. Simple Composition

   C = \$10.66 x +\$0.0032 x q

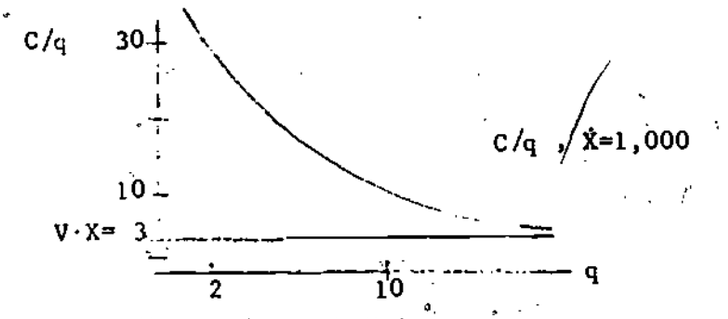
It should be noted that these estimates apply only to journals manufactured in the United States. In one report, estimates for mathematical composition ranged over a factor of six, with a British printer estimating \$20./page for 4,000 pages of composition, U.S. firms estimating between \$40 and \$50./page for the same assignment, and a Far East manufacturer offering a rate of \$7.50/page.[17] Higher proofreading costs would partially offset the lower costs in areas where the native language is not English.

A second limitation of these estimates is the rapid change in printing technology. In the early 1960's, there was an expanding application of computer technology to printing problems, and there has been a continuing refinement of techniques:

> During the past few years, we have seen the movement of typesetting technology shift from a traditionally stable -- or stagnant -- mechanical craft into a rapidly changing and expanding science using principles of electronics, optics, photography, data processing, and other previously alien disciplines.[18]

The technology shows no signs of settling down, so these early estimates are now out of date.

The Case estimates are in line with other estimates made at the same time. Joseph Kuney of the American Chemical Society wrote that the average cost of a journal with a circulation of 10,000 was $.01 per page and for a q=2,000, the C/q was $.03 per page for a 1,000 page chemistry journal.[19] This estimate allows one to move from manufacturing costs to organizational costs. In this example, 2,000 subscribers would have to pay $30. per subscription to keep the 1,000 page journal in business. Assuming that there are no organizational costs which are variable, and that V = $.003, we can solve out for F_1 plus F_2 -- the fixed printing and organizational costs per page:



$$C = (F_1 + F_2)\ X + V\ X\ Q$$

$$60{,}000 = (F_1 + F_2)\ .\ 1000 + .003\ .1000\ .\ 2000$$

$$54 = F_1 + F_2$$

The Operations Research Group estimate of fixed manufacturing costs would be in the range of 20 to 25 dollars; assuming the latter, the organizational costs would have been $29 per page -- even greater than composition.

These organizational costs are often donated when journals are small-scale. Scientific editing, copy-editing and proofreading, and other

forms of editorial assistance may not have to be paid out of subscriptions -- although they are real costs to the economy. Similarly, the administrative side of organization costs may not occur at all. Items such as promotion, general society overhead, publication management, accounting, and subscription servicing may not appear as costs; this may be because the facilities are donated or because the scale does not warrent elaborate business procedures. With nineteen journals, the American Chemical Society could not function without heavy organizational expenses. The economies of scale are such that "voluntary" work would be quite inefficient (expensive in real terms).

Current ACS estimates of the average cost to add one page to a journal with a circulation of 10,000 are in the range of $100. Editorial costs account for about $15, administrative costs for $30, and manufacturing costs for $55. Since the variable manufacturing costs per page (V) are closer to $.0025 than the $.0030 estimated by the O.R. Group, the cost of composition would be approximately $30, with run-off costs (variable costs such as paper and binding) accounting for the rest of the $55 total.

Analysis of cost information from the American Psychological Association yields results that are remarkably similar to those from the American Chemical Society. In 1967, APA's thirteen journals contained 13,801 pages. Their 1967 Journal Operations Financial Report broke expenses down into comparable categories. The average cost per page was $97, with manufacturing (including prerun and runoff costs) accounting for $50.50.[20] Again, organizational expenses weighed heavily in the cost equation. The shift from part-time volunteer to full-time professional work may not involve greater real-cost to the economy. The gains from specialization should mean real savings to the economy -- if not to the particular scientific society.

5.2. Parameterization of the Cost Model

Organizational expenses must be added to the cost equation developed earlier. The introduction of organizational variable costs (V_2) brings cost items such as subscription servicing more into line:

$$C = (F_1 + F_2)\,X + (V_1 + V_2)\,X_q \qquad (1)$$

Differentiating total costs with respect to circulation (q) and pages (x) yields:

$$\frac{dC}{dq} = (V_1 + V_2)\,X \qquad (2)$$

$$\frac{dC}{dX} = (F_1 + F_2) + V\,q \qquad , V=V_1+V_2 \qquad (3)$$

Trade-offs can be obtained for alternative journal policies. For example, if funds are available to add one page to the journal ($F_1 + F_2 + V\,q$), an alternative policy such as increasing F_2 can be explored in terms of benefits it would generate relative to the costs.

It should be noted that in the short run, a single page could be added to a journal without increasing the organizational component of the average cost.

$$C = F_1 X + F_2 + (V_1 + V_2) X q$$

Over time, however, organizations would have to expand to maintain the same quality of editorial assistance or managerial effort. This is particularly true in the area of bibliographic services where the acquisition and processing of abstracts involves heavy fixed costs per item. Furthermore, the costs of expanding coverage have high incremental costs because of the larger number of sources which have to be consulted relative to the "core" journals.

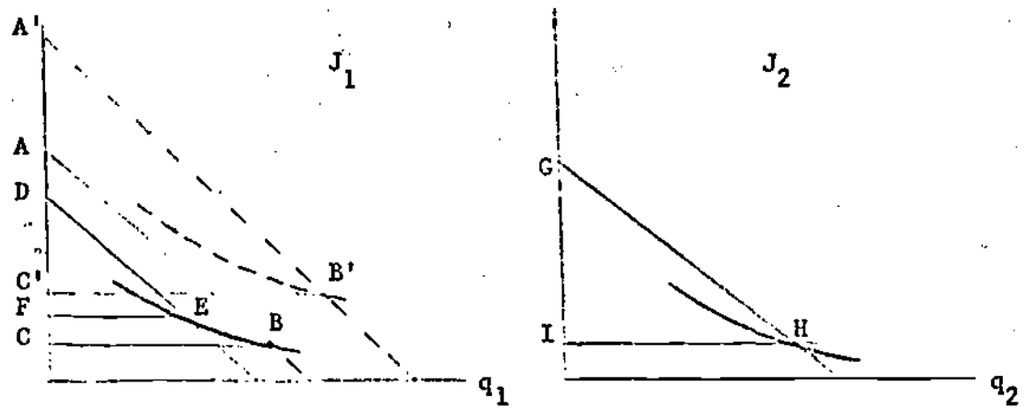
While there is a continuum of arrangements between the highly informal, volunteer operation and the multi-million dollar publishing society, the basic manufacturing costs can be viewed as unavoidable -- with a large proportion of these being fixed for small scale operations. Small operations may not have the organizational expenses of the larger publishers, but they may cause expenses for secondary and tertiary services. Bibliographic and review journals cannot escape the organizational expenses forced upon them by the mere existence of large numbers of small journals.

5.3. Expansion as an Alternative to Entry

A major decision faced by the journal publisher is the size of the product. A strong case can be made for high quality journals to expand pages in order to keep pace with the growth of a discipline. The argument holds only up to the point where bulkiness or other aspects of the journal make sub-division an efficient alternative. The interaction between coverage, entry, and expansion affects market performance.

Although publication lags, author re-submissions, and other elements complicate the picture, the effects of entry on another journal's coverage are clear. This interdependence will have some effect on the demand for the original journal (J_1) - even ignoring the presence of a substitute (in terms of relative prices). A drop in coverage probably reduces the usefulness of a journal for retrospective searching. Thus, entry may have a substantial effect on the demand for other journals in the market. It would be easy to give a numerical example in which entry and the publication of addition pages by two journals is less efficient than expansion of a journal (even when the "quality" of the journal suffers).

Entry vs. Expansion under Average Cost Pricing



The net benefit of J_1 is area ABC in the first time period. With entry the second time period, the net benefit is reduced to DEF (due both to interdependence of demands with respect to coverage and the need to raise prices to cover costs.) DEF plus GHI may be greater than ABC; that is, consumers are willing to pay for the provision of additional articles, and they gain from the situation.[21] However, A'B'C', may be even greater than this. The expansion of pages may generate even more benefits. It should be noted that the total number of subscriptions is only a partial index of the benefit. It could be that entry resulted in a larger total circulation for the two journals, but that expansion generated greater benefits. If the cost function is $K = F_1 + F_2 X + V X q$ there is a set-up cost (F_1) to the journal which is independent of the number of pages. Thus, expansion may well result in lower total costs as well as greater total benefits.

6. JOURNALS IN THE LANGUAGE SCIENCES

The serials of significant and potential relevance to language sciences number approximately 4000 (See Appendix A). An understanding of the growth of this journal network is necessary to project future demand for primary and secondary literature in this field.

The cumulative nature of scientific information is not unique to the language sciences, since all sciences build on previously accumulated knowledge and research. However, the language science literature does not experience the rapid turnover of some of the physical sciences: relevant information does not become obsolete as quickly and must therefore be gathered and maintained in a form that can be made readily available when needed.

Another aspect of language science information affecting the demand for primary literature is the interdisciplinary nature of that information. A professional community's need to know or study some aspect of language for its own purposes gives the language sciences a dimension which goes beyond precise disciplinary boundaries. Language scientists require

information from other disciplines, and scientists from other fields need information generated within the language sciences. This means that information relevant to the language sciences grows more rapidly than the stock of language scientists.

Institutional arrangements affect the market through subscribers and authors. Libraries comprise a significant portion of subscribers for many language science journals. In 1965 28% of the total subscribers to Language were library subscribers; in that same year, libraries made up 60% of the subscribers to Studies in Linguistics. Demand is influenced by both the number of institutions and size of societies concerned with the language sciences. A study of 30 United States organizations related to the language sciences estimates total membership of these organizations at 175,000; the estimate allows for membership overlaps. It is also estimated that the total number of language science membership organizations in the United States is approximately 60.[22]

The increasing amount of expressed need (demand) for language science information is also implied by the growth patterns exhibited by the literature. This derived demand for language science literature depends on both individuals and libraries, in their roles as suppliers of articles and subscribers; the demand is a function of both.

The functional requirements of primary journals (i.e., disseminating, archival, and prestige-conveying functions) which determine the structure of the primary journal market also influence the market for secondary literature. The (exponential) growth in the number of primary journals implies an increased need for bibliographic coverage -- coverage which maintains the present level of information exchange while increasing in response to the rate of primary journal growth. The situation is aggravated with the realization that maintenance of status quo may not be acceptable for meeting information needs. The task of rapidly filling increased specialization needs on the one hand and comprehensiveness on the other surpasses the present scope of most existing periodicals.

575 language science primary journals were individually reviewed for the total number of papers and number of language science papers published in 1967. These journals produced over 27,000 articles in that year, with an estimated 7,300 of these being relevant to the language sciences; the percentage of language science papers per journal ranged between 2% and 100%. There is reason to believe there are in existence three times the number of primary language science journals as those studied, an estimate which would put the total annual number of articles of interest to language scientists at 20,000. There is presently no bibliographic service in the language sciences which undertakes coverage at this scale, to attempt to do so would increase publication time lags and costs tremendously.

The Linguistic Bibliography (LB) is used to illustrate the range of existing problems for secondary coverage of the increasing amounts of primary literature. The LB is a general purpose tool published annually by the Permanent International Committee of Linguists under the auspices of the International Council for Philosophy and Humanistic Studies; it provides a comprehensive listing of references to archival documents in linguistics and related fields. The LB has a publishing lag of approximately two years; it has difficulties remaining financially viable, problems maintaining adequate staffs, insufficient coverage of certain topics and fields, and indexing problems with the information it does obtain. The publishing time lag of the LB added to the publishing lag of the primary literature produces greater than a three year lag between authorship and secondary coverage of the primary literature. This lag must affect user demand for the LB; sales volume would certainly increase if coverage was updated. The difference between actual and potential sales, may mean the difference between financial viability and demise of journals operating under similar handicaps.

The problem of primary and secondary journal publication are similar: to reduce the publishing time lag, without sacrificing desired coverage of the field of relevant literature, while employing least-cost methods for the acquisition, redaction, production, and distribution processes. The technology is available for alleviating many of the pressures created by user demands on periodical publications. However, there may be some trade-offs between economies of scale and the diffusion of editorial power. Some of the seemingly inadequate redaction and publishing procedures of the accepted literature forms can not be completely eliminated; indeed, it is undesirable to attempt to do so. By definition, primary journals serve an important information dissemination function, but publishing time lags can not be reduced to the extent that inadequate refereeing processes would compromise the archival function of primary journals.

It is imperative that LINCS recognize the functional objectives and limitations of existing literature types in terms of their present and future capacity for meeting information needs. Reasonable standards of performance (e.g. customer satisfaction, allocative efficiency of combined production inputs, innovative efficiency) should be applied to reveal deficiencies. Where deficiencies exist remedial steps can be taken to improve existing periodicals and implement new services.

Given the scale requirements of the Language Sciences, cooperation among existing and future facilities and societies will likely prove the best method of producing effective journals for all participating members -- eliminating costly duplication of effort and retrospective coverage. The LINCS program plans to fill publication gaps by enlisting available resources in cooperative publishing efforts, making

the most efficient use of available technology, and achieving economies of scale which accrue as a result of cooperation. For example, a small journal operating with a budget of $30,000 might be unable to make use of a $20,000 facility which could reduce publishing costs by 10%, whereas a group of journals might obtain real cost savings through cooperation. It is the interaction between technology and scale which lends much credibility to the LINCS concept.

Mutually beneficial contracts could be negotiated among national and international organizations which would offer exchanges of primary literature and bibliographic information and services as consideration for binding agreements. Where political barriers exist, it is hopeful that cooperation can be secured, without compromising ideological views or prestige.

Recent trends in journal growth have been in the direction of increased specialization; however, most journals still have relatively low average reader-per-article ratios, indicating quite possibly that further specialization might be in order. To supplement language science journals whose article content covers a wide range of field-related subjects, journals could be produced which would be more strictly subject oriented. The intent would be to supply larger numbers of articles in journal form to those dealing in narrowly defined fields. These specialized journals would perform the functions of regular primary journals and would better meet the particular information needs of those who are reluctant to search journals for articles of potential relevance to them. A number of possibilities exist for achieving increased specialization: 1) creation of new specialized journals; 2) re-portioning existing journals into smaller more specialized packages; 3) creating special issues (of existing journals) which consist of groups of closely related, previously issued articles; 4) group efforts by several journals, again compiling previously related research articles. Specialized journals could be handled by the LINCS system through cooperative and centralized facilities as discussed above.

7. THE BASIS FOR INSTITUTIONAL COOPERATION

This study is only a first step in pulling together the elements comprising the scientific journal market. At present we know relatively little about the operations of the entire system. Data collection is the most important area for immediate improvement, in order that, with more complete information, the operations of the various market mechanisms can be analyzed and simulated. For example, information must be obtained on circulation trends so that the profession can obtain an overview of where documents are being stored. Article rejection rates might provide an early warning system for predicting when journals were about to be born. User profile studies would focus attention on particular information needs so that new journals or specialized journal forms and substitutes could be smoothly brought into existence.

Data storage requirements and the multi-functional use of information can be met through use of computerized systems. But set-up and operational costs are high, so progress will be slow without inter-society cooperation, or subsidization. Language scientists must be prepared to take a hard look both at the need for cooperative efforts and the economic realities of employing available technology. Professionals must become more interested in and concerned with the total information network in the discipline. As small societies begin to recognize that they are not merely distributing journals but are part of a greater information dissemination system, they may be tempted to try partial solutions, resulting in massive duplication of effort. Individual societies must thus be convinced of the economies in coordinating publishing efforts; otherwise, costs may be so prohibitive as to restrict or obscure program goals or financial viability. However, services which appear desirable and institutionally feasible are not always economically obtainable or justified in terms of fulfilling user requirements or efficiency of operation. Cooperative ventures which are operated by representatives of producers and consumers may have a tendency to be self-perpetuating and therefore costly to modify. In addition to the development of procedures for insuring accountability, incentive structures must be devised to keep LINCS (a technological monopoly) from behaving like a monopoly.

When determining the efficiency of institutional change, economists usually assume the presence of a given technology and preferences. In the market described in this paper, the presence of decreasing costs and interdependent demands results in a strong case for institutional intervention. It is not clear, however, that the present patterns of partial subsidization are optimal in the absence of some way of considering demand interdependencies. Problems of specialization, coverage, and publication lags further complicate the determination of efficient allocative decision-making.

In a broader sense, institutional change should promote innovative efficiency as well. Technical studies can give decision-makers a better guide to possibilities opened up by technological change, and behavioral studies can give decision-makers more knowledge about the preferences of researchers. It makes little sense to explore communications media other than journals without having an understanding of how present channels are used. Then additional channels can be explored including microfilm, microfiche, and machine-readable abstracts -- only a few products made possible through miniaturization and computerization. But given the public goods nature of technological information, joint ventures or some form of cooperative effort is necessary to provide incentives and capacity for work in this area.

The product under consideration is the delivery of information services to the discipline. Journals happen to have a major share of this broader market. We have seen that journals are complicated products, and suggestions have been made for institutional change to improve both allocative and innovative efficiency. The changes require a shift from independent decision-making within a monopolistically competitive framework to cooperative behavior by representative bargaining agents, i.e. through LINCS. If our communications networks are to perform efficiently in the future, it is essential that we explore more fully how economic scarcity interacts with non-market factors in this sector of the growing knowledge industry.

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APPENDIX A

PUBLICATIONS IN THE LANGUAGE SCIENCES

Ludmila Okreglak

Approximately 4,000 serials containing language sciences material have been identified by the LINCS program. Table 1 shows the number of journals identified in the language sciences in the United States and abroad, and their percentage of language sciences content Table 4 contains serial growth projections for 1976 based on an estimated doubling period of 18 years for journal articles in the language sciences.

Included in the first column of tables 1 and 2 are core journals whose contents are almost entirely (96%-100%) concerned with the language sciences (i.e. general linguistics, theoretical linguistics, dialectology, phonology, lexicology, language specialties, etc.). Representative of this group are Language, Foreign Language Annals, Orbis, Onoma, Phonological Studies, Voprosy jazykoznanija.

The second column represents periodicals in which language sciences materials comprise 51% to 95% of the contents. These journals are drawn from those which cover not only pure language science but also literature and historical and comparative studies, as well as from those in fields closely related to the language sciences such as philology and anthropology. Typical are Aevum (Rassegna di scienze filologiche, linguistiche e storiche), Acta Philologica Scandinavica, Anthropos (Revue internationale d'ethnologie et linguistique).

Column three includes serials from the fields of psychology, sociology, education, the humanities, and other areas, where language sciences materials constitute 21% to 50% of the contents. Examples are Journal of Psychological Research, Canadian Journal of Behavioral Sciences, Sociologia Internationalis, Special Education.

Column four (less than 20%) contains periodicals from the biomedical sciences, history, philosophy, and other sciences not directly related to linguistics. These journals occasionally include materials of interest to language scientists. Examples are Pediatric Research, Otorhinolaryngologia, Acta Neurologica et Psychiatrica Belgica, Philosophia naturalis, Special Libraries, Scientific and Technical Information, Studii si Cercetari Matematice.

Tables 3 and 4 contain estimates for 1971 and 1976, respectively, of published outputs in the language sciences. The average number of serial articles per annual volume has been estimated to be 23 for the core groupings, 17 for the 51-95% group, 8 for the 21-50% group, and

3 for the under 20% group. Table 4 for 1976 reflects the average growth rate estimated for publications in the language sciences: the literature in the language sciences is assumed to double every 18 years.

Table 1. Serial Publications in the Language Sciences, 1971, By Percentage of Language Sciences Content

	96%-100% (core)	51%-95%	21%-50%	less than 20%	Total
U.S.A.	100	240	300	500	1,140
Foreign	430	530	900	1,000	2,860
Total	530	770	1,200	1,500	4,000

Table 2. Serial Publications in the Language Sciences, 1976, By Percentage of Language Sciences Content

	96%-100% (core)	51%-95%	21%-50%	less than 20%	Total
U.S.A.	120	300	370	610	1,400
Foreign	520	650	1,100	1,220	3,490
Total	640	950	1,470	1,830	4,890

Table 3. Estimated per annum Number of Message Units in the Language Sciences, 1971 (Including Articles by Serial Groupings, cf. Table .)

	96%-100% (core)	51-95%	21%-50%	less than 20%	Total
U.S.A.	2,210	4,140	2,400	1,500	10,250
Foreign	9,900	9,030	7,200	3,000	29,130
Total	12,110	13,170	9,600	4,500	39,380

Table 4. Estimated per annum Number of Message Units in the Language Sciences, 1976 (Including Articles by Serial Groupings, cf. Table .)

	96%-100% (core)	51%-95%	21%-50%	less than 20%	Total
U.S.A.	2,680	5,040	2,920	1,830	12,470
Foreign	12,040	10,990	8,760	3,650	35,440
Total	14,720	16,030	11,680	5,480	47,910